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SECOND ANNUAL REPORT

National Steering Committee for
Aerial Application of Pesticides -
Seed and Cone Insects

April 18, 1989

USDA Forest Service
Washington Office/Forest Pest Management
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CONTENTS

I. INTRODUCTION

The second annual meeting of this committee met in Salt Lake City, UT, on November 8-9, 1989.

A. Committee Members

Larry Barber	R-8/FPM (Asheville, NC)
Scott Cameron	TX Forest Service (Lufkin, TX)
Gary DeBarr	SE/FIDR (Athens, GA)
Jed Dewey	R-1/FPM (Missoula, MT)
Wayne Dixon	FL Division of Forestry (Gainesville, GA)
Peter deGroot	FPMI (Sault St. Marie, Ontario)
Kees van Frankenhuyzen	FPMI (Sault St. Marie, Ontario)
Mike Haverty	PSW/FIDR (Berkeley, CA)
Tom Hofacker	WO/FPM (Washington, DC)
Dave Overhulser	Oregon Department of Forestry (Salem, OR)
Charles Masters	Weyerhaeuser Co. (Centralia, WA)
Chris Niwa	PNW/FIDR (Corvallis, OR)
Max Ollieu	WO/FPM (Washington, DC)
Roger Sandquist	R-6/FPM (Portland, OR)
John Taylor	R-8/FPM (Atlanta, GA)
Jack Barry (Chair)	WO/FPM (Davis, CA)

Four other members, Peter deGroot and Kees van Frankenhuyzen (FPMI); and Tom Hofacker and Max Ollieu (WO-FPM) were not able to attend. Since the meeting Tim Schowalter, entomologist, Oregon State University has accepted our invitation to join this committee.

B. Purpose of Committee

The purpose of the committee is to review, identify, and recommend needs for field tests, pilot projects, and demonstrations of application of pesticides. Needs include those associated with pesticides, application systems, techniques, and strategies that

influence the FS's and State cooperator's ability to use pesticides safely, effectively, and in an economically and environmentally acceptable manner.

C. Operating Guidelines

Operating guidelines generic to the four FPM national steering committees are enclosed (Appendix A). The committee also recommends an additional guideline as stated in paragraph III., H., 1., "scope of this committee shall include all methods of managing seed and cone insects."

II. RECOMMENDATIONS

Recommendations are ranked by priority with 1 being the highest priority. Committee's recommendation of who should take the lead also is included with each recommendation.

A. Laboratory/Field Studies

1. **Develop methods to monitor major seed and cone insects, and to predict population levels and treatment timing.**

   High Priority (1) - M. Haverty
   C. Niwa

2. **Study and establish relationship of pest levels to subsequent damage by major seed and cone insects.**

   High Priority (2) - M. Haverty
   C. Niwa

3. **Develop toxicity data for seed bug and establish lower thresholds.**

   High Priority (3) - G. DeBarr

B. Field Tests

1. **Conduct field tests of pyrethroids in Douglas-fir orchards:**

   a. **Evaluate pyrethroids as alternatives to systemic insecticides for control of gall midge.**

   High Priority (1) - M. Haverty

   b. **Evaluate other pyrethroids as alternatives to Asana for control of cone worm and chalcid.**

   High Priority (1) - M. Haverty

2. Conduct field tests of undiluted B.t. to control target species of Dioryctria in eastern and western seed orchards.

Low Priority - M. Haverty
G. DeBarr

C. Demonstrations

1. Demonstrate utility of FSCBG aerial spray model to plan an aerial spray project in a western and eastern seed orchard.

High Priority (1) - J. Barry

2. Demonstrate understory burning strategy to control white pine cone beetle in Ohio, Pennsylvania, and North Carolina white pine seed orchards.

High Priority (1) - L. Barber

3. Demonstrate feasibility of single-tree treatment using a helicopter.

Low Priority - MTDC

D. Cooperative Field Projects

The following projects have been funded and are scheduled to be conducted in 1990. Assigning priorities to these funded projects was not deemed to be applicable. No other cooperative field projects are recommended as results of 1989 field tests are unknown at this time.

1. Conduct a field test (replicated) in two or more southern pine seed orchards to control Dioryctria using undiluted B.t. applied by aircraft at 30 BIU per acre.

L. Barber

2. Conduct field tests (replicated) in two Oregon seed orchards using a regime of pesticide and number of treatments, applied by both aircraft and ground sprayers to control a Douglas-fir pest complex.

R. Sandquist

3. Conduct a project to evaluate feasibility of a pheromone to disrupt mating of Dioryctria disculsa.

L. Barber

4. Conduct a field project to evaluate stem implants of acephate, metasystox, and dicrotophos to control seed and cone insects in R-1 and R-8.

L. Stipe
J. Negron

5. Continue field evaluation of Capture (a synthetic pyrethroid) to control seed and cone insects.

L. Barber

E. Equipment and Technology Development

1. Develop a tree injection or infusion method that is safe, economical, and minimizes tree damage. High resin levels in pines present a tough problem.

High Priority - WO/Engr.

2. Conduct an engineering study to evaluate both ground and aerial equipment for dispersal of pheromones in fibers, capsules, flakes, pellets, and granules. The study, to be conducted in close coordination with FIDR should evaluate existing hardware and identify need for hardware development.

Medium Priority (1) - WO/Engr.

3. Evaluate existing or develop new hardware for applying aerial sprays to single or clustered trees. Seed collection trees in wild stands seldom can be treated effectively from the ground. Aerial application currently is the only practical method of treatment. A helicopter spray system is needed. This may simply involve testing or modifying an existing system.

Medium Priority (2) - WO/Engr.

F. Information Management

Prepare a reference of labels and Material Safety Data Sheets (MSDS) on pesticides registered to control seed and cone insects.

High Priority - J. Barry

G. Administrative

1. Develop and maintain seed and cone insect management skills in Regions and NA.

High Priority (1) - J. Space

2. Contact EPA and discuss need to classify pesticides used for seed and cone insect control as non-food crop and relaxation of pheromone pesticide registration requirement.

High Priority (2) - M. Ollieu
G. DeBarr

3. Determine allocation of resources at Regions (TM and FPM), NA, and Stations for managing seed and cone insects; and to communicate to decision makers need for more research on reducing losses from seed and cone insects.

   High Priority (3) - M. Ollieu

4. Develop an IPM decision making approach to manage seed and cone insects.

   High Priority (4) - M. Haverty

5. Encourage evaluation and testing of new pesticides and biorational methods to control seed and cone insects, recognizing the susceptibility of dimethoate (Cygon) and azinphos-methyl (Guthion) to de-registration.

   High Priority (5) - M. Ollieu

6. Invite a seed and cone scientist from academia to join this committee.

   Medium Priority (1) - J. Barry

7. Recommend that persons who develop seed and cone insect project proposals submit their proposals to this committee for constructive review.

   Medium Priority (2) - M. Ollieu

H. Operating Guidelines

1. Expand scope of this committee to include all methods of managing seed and cone insects and propose that the committee name be changed to National Steering Committee - Management of Seed and Cone Insects.

2. Conduct of field tests (experiments) in seed orchard and wild stand collection sites shall follow applicable parts of <u>Recommended Guidelines for Designing Field Experiments of Insecticides for Control of Insect Defoliators by Aerial Application</u> drafted by Pat Shea 8-8-89.

III. ACCOMPLISHMENTS

A. Committee's 1988 Recommendations and Accomplishments. Summarized below are accomplishments related to the committee's recommendations.

1. Field Experiments and Related Studies

   a. PSW is continued research on impact of seed and cone insects on ponderosa pine, western white pine, and sugar pine (see Hagerty Appendix B).

b. PNW is continued research on a monitoring system for Douglas-fir seed chalcid and pheromone identification of the fir coneworm.

c. James B. Hoy and Michael I. Haverty described by the authors in Pest Management in Douglas-fir Seed Orchards: A Microcomputer Decision Method, General Technical Report PSW-108, Sept. 1988.

d. PNW and SE conducted some limited field work with pheromones to evaluate use of mating disruption to manage *Dioryctria disclusa*.

e. Some promising insecticides were evaluated in the East (B.t. aerially applied and chemical pesticide implants) and in the West (Guthion and Asana XL aerially applied and chemical implants in larch and ponderosa pine).

f. PNW, R-6, and WO/FPM evaluated several techniques to measure pesticide spray deposition and coverage during a cooperative field project at the Heather Orchard, Willamette NF.

2. Demonstrations and Pilot Projects

a. Some limited work was accomplished by R-6 and R-8 in looking at the environmental fate of pesticides. No work was done to study the fate of ultra low volume applications.

b. Utility of the Forest Service Cramer-Barry-Grim (FSCBG) aerial spray model was evaluated by WO/FPM (Davis) in cooperation with R-6 during the Heather Orchard project.

3. Administrative

a. WO/FPM in cooperation with WO/FIDR, PNW and SE have been negotiating with EPA on the issue of experimental use permits and pesticide exemption for pheromones.

b. R-8 has initiated their 5-year seed and cone action plan.

c. Funds have been made available to SE/R-8 to consolidate the Southeast's pheromone data-base with a 1991 target completion date.

B. Committee Member Reports

Reports by committee members Larry Barber and Jose Negron, Mike Haverty, Gary DeBarr and John Taylor are enclosed in Appendix B.

IV. SUMMARY

The National Steering Committee for Aerial Application of Pesticides - Seed and Cone Insects met in Salt Lake City, UT, on November 8-9, 1989. The committee reviewed and discussed 1988 recommendations, 1989 field projects, and developed recommendations for furthering and improving management of seed and cone insects. The committee membership was expanded to include State and industry cooperators, and an invitation was extended to Canada to send representatives. The committee was pleased with progress of field work during 1989, but continues to emphasize the need to adequately support field work. The committee is especially concerned that there are too few chemical pesticides available and that some of these may be in jeopardy of de-registration. The committee further suggested that the committee's name and scope be changed to include all methods of managing seed and cone insects. The committee's next meeting is planned for Portland, OR or Eugene, OR, June 12-14, 1990, hosted by Roger Sandquist and Chris Niwa.

APPENDIX A
OPERATING GUIDELINES

OPERATING GUIDELINES
FOR
NATIONAL STEERING COMMITTEES
CONSIDERING
FIELD TESTS AND PILOT PROJECTS
FOR THE
AERIAL APPLICATION OF PESTICIDES

MEMBERSHIP: Committees members should be nationally recognized research, developmental, and applied scientists as well as natural resource professionals drawn for the most part from the Forest Service but also from other Federal and State agencies.

PURPOSE: The committees' primary tasks are to analyze, identify, and recommend field and pilot testing needs for aerial application of pesticides. Needs include those associated with pesticides, application systems, techniques, and strategies that influence the FS's and State cooperators ability to use pesticides safely, effectively, and in an economically, and environmentally acceptable manner.

PROCEDURES:

The committees shall:

- meet at least annually, preferably during late summer or early fall so recommended projects can be considered for approval, funding, and implementation the next field season.

- focus on sound science that may lead to improving pesticide application consistent with its stated purpose.

- assign priorities to testing needs agreed to by the committee.

- review data and progress of field and pilot tests.

- suggest who might conduct future tests and where the tests might be conducted.

- take action to address needs such as development of guidelines for field test and pilot projects, database formats, and literature studies.

- establish sub-committees to pursue single issues such as review of laboratory and field test data.

The members shall:

- determine pesticide application needs within their geographical, administrative or organizational area prior to each meeting.

- be cognizant of all appropriate Region/Area/Station/State/cooperator needs.

- bring to the meeting needs that have been discussed with line officers and staff.

- represent the unit's needs within the national perspective of the committee.

The Director FPM/WO shall:

- coordinate the report recommendations within WO, and with the Regions, NA, and Stations as appropriate.

- review the steering committee recommendations and resultant FPM project proposals for funding.

- give strong consideration to the steering committees recommendations in prioritizing project proposals for funding.

- complete project approval and funding by January for projects funded by FPM.

APPENDIX B
Larry Barber &
Jose Negron

REGION 8 PILOT PROJECT STATUS THROUGH OCTOBER 1989

PRESENTED TO THE NATIONAL SEED ORCHARD STEERING COMMITTEE

NOVEMBER 8, 1989

SALT LAKE CITY, UTAH

LARRY R. BARBER AND JOSE NEGRON

FORAY AERIAL APPLICATION PROJECT

Foray was sprayed at 30 BIU'S per acre neat and the primary insect targets were coneworms, Dioryctria spp. The pilot project was conducted on slash pine in the Florida Division of Forestry Seed Orchard near Munson, Florida. We used two insecticide treatments (two blocks of each) and one untreated block. The treatments were Foray and Foray (.625 ga./ac.) plus Asana XL (5.2 oz/ac.). The latter treatment should have controlled the entire compliment of seed and cone insects including seed bugs while the Foray treatment alone should have controlled only coneworms. The sample trees were sprayed five time from May through September. The insecticides were applied with a Thrush fixed wing aircraft fitted with six micornair AU 5000 rotary atomizers.

Coneworm damage in the untreated block was 29.28 percent as compared to damage ranging from 2.84 to 9.45 percent in the insecticide treated blocks Appendix 1. There does not appear to be a difference between insecticide treatments as far as coneworm damage is concerned. We have not collected the conelet crop at this time therefore we have no data to determine seed bug control by the two insecticide treatments.

This study needs to be repeated next year in several sites to further validate this years work. If further studies yield similiar results then the safety and cost of the product would make it the overwhelming favorite of the southern orchard managers. The cost of material applied per acre would be less than $10 per application as compared to $30-40 for conventional insecticides such as Guthion or Asana.

CAPTURE/TALSTAR AERIAL SPRAY TRIALS

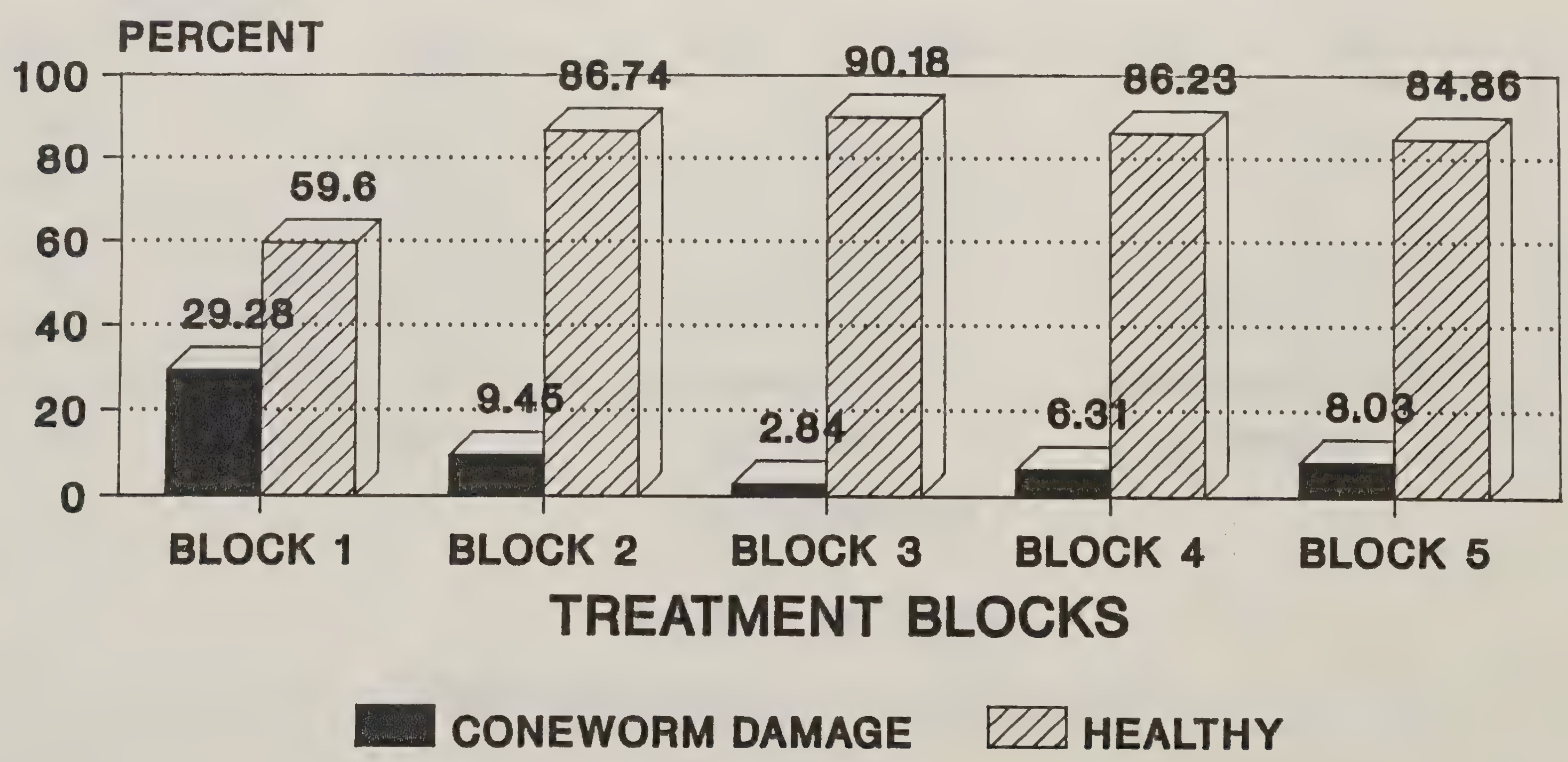
Capture was applied to two seed orchards during 1989. The tests were in the Union Camp, second generation loblolly complex near Claxton, Ga and the other was in the Container Corporation of America second generation loblolly orchard near Brewton, Al.

The Union Camp orchard was sprayed 5 times during the summer at a rate of 10 gallons of solution per acre. Capture was applied at 0.3 lbs a.i./ac. and Guthion at 3 lbs a.i./ac. There were three treatments, including a untreated check with three replicates of each. Both the Capture and Guthion 2L treatments appear to be better than the untreated plots for the control of conewoms Appendix 2. Coneworm damage in the untreated blocks was 11.41 percent as compared to 4.81 and 4.44 percent in the Capture and Guthion treated blocks respectively. This data has not been analyzed. The seed have not been extracted, therefore there is no seed bug control data.

The Container Corporation of America was the site of the second test of Capture. Capture and Guthion 2L were applied with an AgCat aircraft using six micronair AU 5000 rotary nozzles. Both insecticides were applied at rates of one gallon per acre. The Capture was applied at 0.3 lbs a.i./ac. and the Guthion at 1.0 lbs. a.i./ac. The Guthion was applied neat and the Capture was applied with an appropriate amount of vegetable oil to bring the mixture up to one gallon per acre. We made three treatments to the orchard blocks during the spring and summer of 1989. There were 2 replicates of each treatment block ie., Capture, Guthion, and untreated.

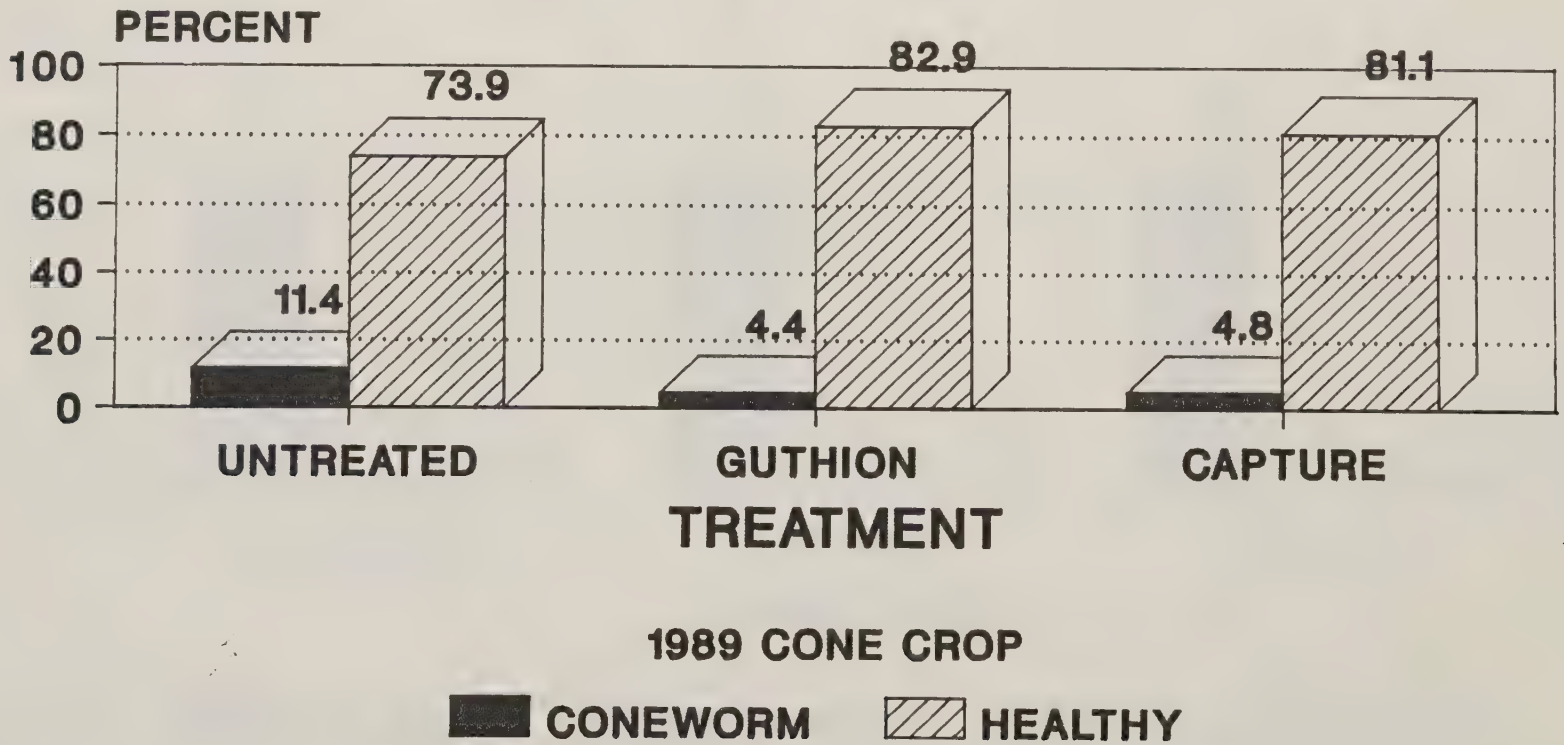
There were no cones on the trees during 1989 because of a hard freeze during the flowering period in March 1988. Our primary emphasis in this study was to control seed bugs on the 1989 flower crop during the summer of 1989. In 1990 we will increase our spray schedule to control all seed and cone insects. We did however notice that in the two insecticide treatment blocks by the end of summer there were more surviving flowers than in the untreated blocks Appendix 3. This indicates a reduction in seed bug populations in the two treatment areas as compared to the untreated checks. Flower and conelet losses are often associated with feeding by seed bugs.

1989 FORAY PILOT PROJECT
MUNSON, FL.
1989 CONE CROP



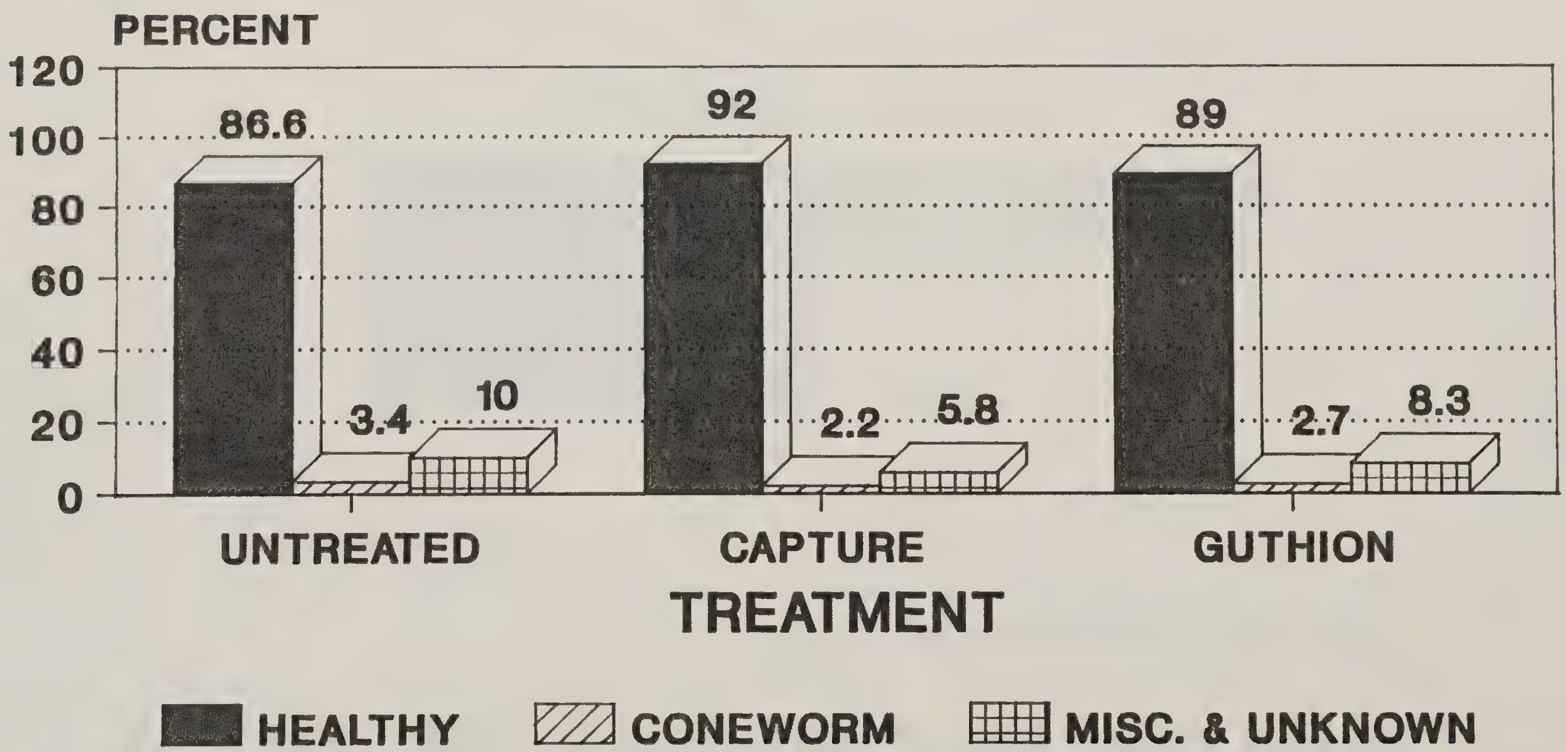
BLOCK 1 = UNTREATED
BLOCKS 2&3 = FORAY 30 BIU
BLOCKS 4&5 = FORAY + ASANA

1989 CAPTURE PILOT STUDY
UNION CAMP CORPORATION
CLAXTON, GEORGIA



GUTHION 3 LBS/AC
CAPTURE 0.3 LBS/AC
SOLUTION AT 10 GA/AC

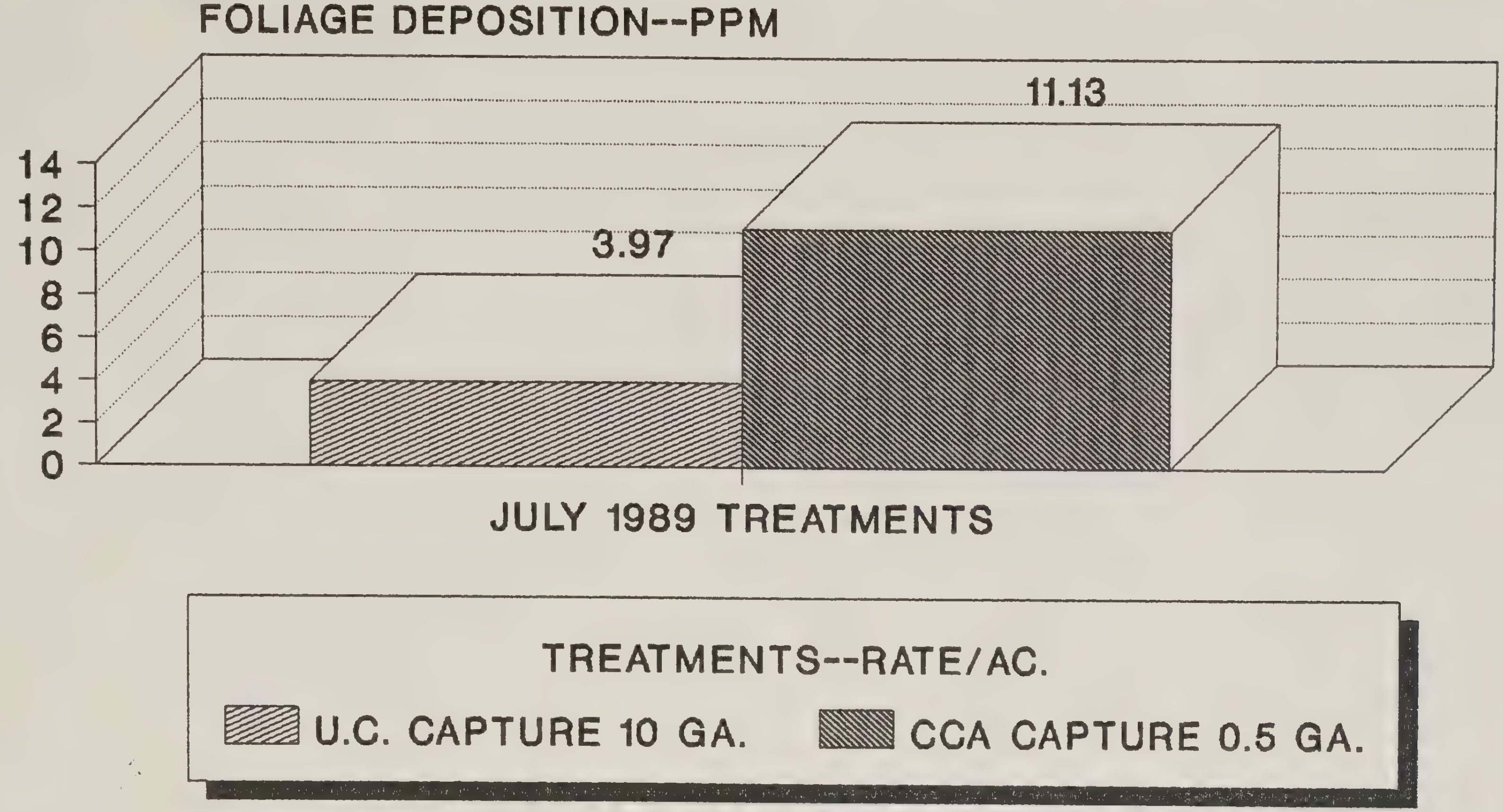
1989 CAPTURE PILOT PROJECT
BREWTON, AL.
1989 FLOWER CROP



CAPTURE 0.3 LB. A.I./AC.
GUTHION 1.0 LB. A.I./AC
SOLUTION - 1 GAL./AC.

FOLIAGE DEPOSITION DATA

HIGH VS. LOW VOLUME AERIAL APPLICATION
CAPTURE APPLIED @ 0.3 LBS. A.I./AC.



UNION CAMP--CLAXTON, GA. 10 GA./AC.
CCA--BREWTON, AL. 0.5 GA./AC.

APPENDIX B
Mike Haverty

1989 REPORT FOR THE NATIONAL STEERING COMMITTEE
AERIAL APPLICATION OF PESTICIDES--SEED AND CONE INSECTS

Michael I. Haverty, PSW Station, Berkeley

Our Research Work Unit did not conduct, nor were we cooperators, in field tests, pilot tests, administrative studies, demonstrations or operational control projects that involved aerial application of pesticides for control of seed and cone insects. Our research program is comprised of projects in four basic areas: biology, impact, systemic insecticides, and ground application of insecticides.

Biology

1. Characterization of cuticular hydrocarbons for identification of cone and seed-damaging insects is a significant effort in our group. The insects of particular concern are the cone beetles (Conophthorus), cone worms (Dioryctria) and other cone-feeding insects such as Choristoneura and Leptoglossus. The purpose of these studies is to investigate another set of taxonomic characters (hydrocarbons) for species identification. Correct identification of an insect species is critical to the study of the biology of "pest" species. Development of pest management strategies requires correct identifications. For many of the insects listed above, there is a paucity of information on biology or species status of the insects that infest cones of pines and Douglas-fir.

2. Related to the hydrocarbon investigations are studies of isoenzymes and DNA restriction fragment length polymorphisms of cone and seed insects. Currently these studies are limited to Conophthorus and Dioryctria. The former genus now has a good biological and taxonomic data base. The latter genus is in critical need of additional taxonomic, genetic and biological clarification.

3. This year one of our entomologists initiated a cooperative project in France to develop "bait-and-switch" technology to disrupt host-location in the Douglas-fir seed chalcid, Megastigmus spermotrophus. From previous experiments we know that this insect utilizes volatile host kairomones to locate suitable oviposition sites. To identify the chemical cue(s), a technique was developed using a chromatographic substrate to trap volatile chemicals from cones and foliage. The technique was refined, and cones and foliage were sampled from susceptible and resistant clones throughout the growing season. Chemical profiles will ultimately be associated with cone phenology and chalcid attack rates. Early results suggest that chalcids may exploit differences in monoterpene compositions of cones and foliage to locate oviposition sites. Electroantennogram and olfactometer studies will confirm the attractive nature of fractions unique to cones. Field assays will follow.

Impact

1. We have been working for nearly 7 years on a study to determine the annual variation in the distribution of damage caused by cone and seed insects in Douglas-fir seed orchards in California, Oregon, and Washington. The original and primary purpose of this survey was to identify the most important or damaging insects to set priorities for our research program. A secondary goal was to ascertain the role of geography, genetics and adjacent land uses in

relation to seed losses. We also provided a service by informing seed orchard managers of the severity of insect problems in their orchards.

2. One of the insects for which we need additional information for all species of conifers in the West is the western conifer seed bug, Leptoglossus occidentalis. We have been investigating a preferential staining technique for L. occidentalis to see if we can identify puncture wounds in individual seeds or cones. Nymphs and adults possess polygalacturonase (PGAs) and pectinmethylesterase (PMEs) in their salivary enzymes and are capable of depolymerizing various plant matrix heteropolysaccharides. These enzymes are injected by these bugs into the plant through their mouthparts to facilitate feeding. Puncture-wounds in cones scales resulting from pectinmethylesterase activity in the saliva of these bugs were visualized by staining with a 0.05% aqueous solution of ruthenium red. This staining technique has been used to identity feeding damage by L. occidentalis on cones of sugar pine, western white pine and Douglas-fir. Further research is planned to take advantage of this technique for 'real-time' assessment and monitoring of seed bug damage in orchards. In addition, this preferential technique will be tested on individual seeds and other reproductive tissue ie., primordial cone buds, flowers, and conelets.

3. We are increasing our understanding of the impact of insects in blister rust-resistant western white pine and sugar pine seed orchards in western Oregon and California. In 1989 two bagging studies were initiated to determine the phenology of insect occurrence and impact in western white pine (Dorena Tree Improvement Center) and sugar pine (Charles E. Sprague) orchards. In each study used 6 bagging periods (treatments) plus a completely unbagged and completely bagged treatment.

4. Life table studies of ponderosa pine cones have been established in a seed orchard in central California and in natural stands in Washington and Oregon (in cooperation with R.E. Sandquist, R-6). The objectives of these studies are to identify, quantify, and determine the biologically-important mortality factors (insects and other biotic and abiotic factors) of ponderosa seed and cones. Preliminary data from the orchard study indicate that there is a significant difference in conelet mortality between seed zones, among clones within seed zones and among crown strata within clones. The factors responsible for this mortality have yet to be determined.

Systemic Insecticides

1. We are studying accumulation and temporal distribution of the systemic insecticide, acephate (in Acecaps), in western larch. So far we have only been able to determine translocation of acephate from bole-implanted capsules to foliage, because the cone flowers have been destroyed by frost. In addition to acephate, several other systemic insecticides may be tested. These include carbofuran, dimethoate and possibly a synthetic pyrethroid (the systemic nature of these insecticides is not known). Similar studies are also planned for Douglas-fir in California.

2. Timing of insecticide implants is another variable under investigation. In ponderosa pine the objectives are to measure residues within the crown and to determine the distribution patterns attributed to fall or spring applications. This should provide background information when considering the best management

strategy for specific insects. In Douglas-fir implanting acephate in the spring at bud burst, or when cones are turning pendant, significantly reduced damage by the fir coneworm and the Douglas-fir cone moth. Infestation levels of Douglas-fir cone gall midge and the Douglas-fir seed chalcid were not affected. We have initiated cooperative studies with R-6 to investigate fall and spring implants of acephate, dimethoate and carbofuran to determine the effect of seasonal implants on all four cone insects. We are particularly interested in effective implant timing for the gall midge and seed chalcid. New systemic insecticides will need to be evaluated to control these latter, important pests of Douglas-fir seed production.

3. Another approach under investigation is the translocation of micro-encapsulated systemic insecticides within the xylem of conifers. The usual methods of applying systemics are: (1) spray aqueous solution on foliage, (2) incorporate insecticide into the soil, (3) inject fluid insecticides into the bole, or (4) implant a capsule containing an insecticide into the bole of the tree. The approach we will try next field season is to drill holes in the boles and place micro-encapsulated insecticides, carbofuran and carbosulfan, directly into the tree. We plan to test this strategy in the major conifer species in California--Douglas-fir, ponderosa pine, sugar pine, and white fir. To begin with, we will measure insecticide levels only in foliage and cone tissues. Assessment of efficacy may come next.

4. A comparison of efficacy of implanted acephate and ground applications of dimethoate for protection of Douglas-fir seed crops was initiated in four seed orchards in Oregon. Seed production has yet to be analyzed, but preliminary indications are that both treatments reduced the amount of damage by lepidoptera (primarily Dioryctria) and Douglas-fir cone gall midge, but not in all orchards. Orchard location clearly affected the results.

Ground Application of Insecticides

1. An assessment of efficacy of single or multiple applications of esfenvalerate for protection of blister rust-resistant western white pine seed crops in Oregon was started this season. This strategy and insecticide have been found effective in northern Idaho and is being verified at the Dorena Tree Improvement Center where we have a more complete complex of cone and seed pests. The insecticide is a new formulation of the most toxic isomer of fenvalerate. Early indications are that the cone crop was too large and the insect population too small to assess efficacy. We'll known soon!

Hoy, James B.; Haverty, Michael I. 1988. **Pest management in Douglas-fir seed orchards: a microcomputer decision method**. Gen. Tech. Rep. PSW-108. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 29 p.

The computer program described provides a Douglas-fir seed orchard manager (user) with a quantitative method for making insect pest management decisions on a desk-top computer. The decision system uses site-specific information such as estimates of seed crop size, insect attack rates, insecticide efficacy and application costs, weather, and crop value. At sites where information on insect attack is not available, regional attack rates within the program may be used. The heart of the decision system is a payoff analysis. It evaluates alternative management actions and identifies the best action under the best or worst conditions, and the action that minimizes the opportunity cost. Tutorial help is included in the program as well as utility programs for entering local weather data.

Retrieval Terms: Douglas-fir, seed orchard, pest management, pest control decision method, payoff analysis, frost damage probability estimation

The Authors:

JAMES B. HOY is a research entomologist with the Station's research unit studying insect biology and control, in Berkeley. During the genesis of this report, he was a research associate in the Division of Biological Control, Department of Entomological Sciences, University of California, Berkeley.

MICHAEL I. HAVERTY is a principal research entomologist and leader of the research unit.

Acknowledgments:

We had the help of many members of the Northwest Seed Orchard Managers' Association in preparing this decision system. We thank Donald L. Dahlsten, for his encouragement, David L. Rowney for his programming assistance, and William A. Copper for preparing flowcharts. Michael A. Bordelon, William R. Cook, and Gordon E. Miller kindly reviewed the manuscript and provided many helpful suggestions. This project was supported, in part, through a cooperative aid agreement between the Pacific Southwest Forest and Range Experiment Station and the Division of Biological Control, Department of Entomological Sciences, University of California, Berkeley.

Publisher

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September 1988

APPENDIX B
Gary DeBarr

Nov. 1989

Gary L. DeBarr, Research Entomologist
SE-4501 Athens, Georgia

Current Research:

1) Use of prescribed fire to control the white pine cone beetle in eastern white pine seed orchards. (DeBarr, Barber, Manchester and Wade).

Objective: To determine the feasibility of using fire as an alternative to insecticides for cone beetle control.

2) Mating disruption of Dioryctria spp. using synthetic sex pheromone deployed in seed orchard trees. (DeBarr, Nord and Niwa)

Objective: To determine the feasibility of using mating disruption to control coneworms, Dioryctria spp., in loblolly pine seed orchards.

3) Demonstration and identification of pheromones for the white pine cone beetle. (DeBarr, Birgerson and Berisford)

Objective: To show that C. coniperda produces and uses pheromones and to chemically identify pheromone components.

4) Effect of temperature on the development of L. corculus and T. bipunctata. (Nord, DeBarr, and McGuiness)

Objective: To determine the relationship between temperature and insect development and to develop degree-day models for L. corculus and T. bipunctata for timing control applications and predicting number of generations/year across southern U.S.

5) Determination of feeding impact of 2nd-stage L. corculus nymphs on loblolly pine conelets. (Nord and DeBarr)

Objectives: a) To determine the number of ovules destroyed/nymph/day. b) To determine the number of ovules destroyed/day/nymph among seasons and clones. c) To determine the number of damaged ovules required for conelet abortion.

6) Pheromone detection of Dioryctria spp. in Southern pine seed orchards: Analysis of 10 years of Southwide trapping data.

Objectives: a) To integrate existing information into one data base accessible by microcomputers for use by researchers and practitioners. b) To analyze trapping data for population trends, regional distributions, species interactions, activity periods, data varibility and damage preditions.

7) Outbreaks of scale insects associated with pyrethroid use in southern pine seed orchards. (Clarke, DeBarr, Negron and Berisford).

Objectives: To determine why scale insect populations increase following the use of pyrethroids for cone and seed insect control. b) to compare pyrethroids and develop guidelines to minimze outbreaks in orchards.

D1 T1

1989 WHITE PINE CONE BEETLE PHEROMONE STUDY

Gary L. DeBarr, Goran O. Birgersson, and C. W. Berisford

OBJECTIVE: To demonstrate the presence of pheromones of the white pine cone beetle, Conophthorus coniperda, chemically identify those pheromones, and to conduct preliminary studies on their utility of integration into control programs

METHODS: Volatiles from air passed over unifested eastern white pine cones, or cones infested by male or female white pine cone beetles were collected on Porapac. Ether extracts of the Porapac were bioassayed for male and female response in the laboratory. Compounds were identified by GLC-mass spectroscopy. Attraction to male and female infested cones, extracts, and synthetic pheromones were evaluated during the spring attack period in the USFS Beech Creek Seed Orchard using two types of traps suspended in the tree crowns.

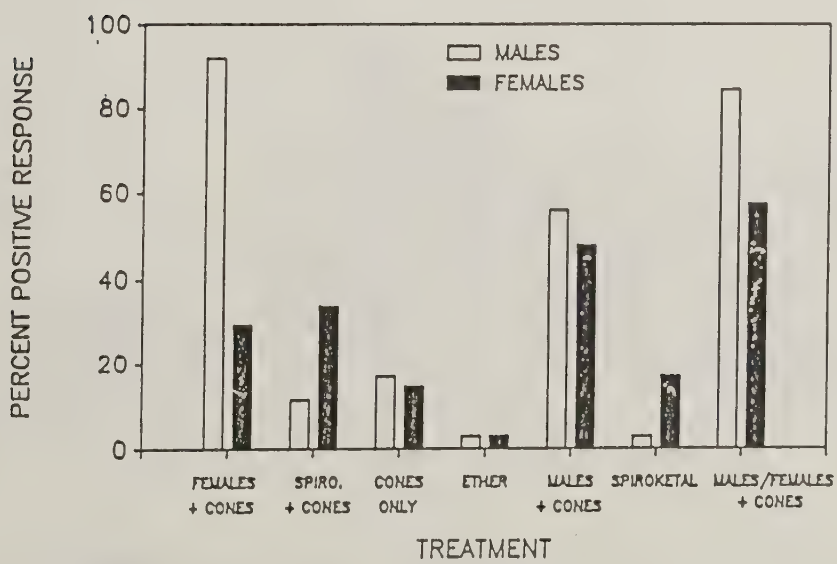
RESULTS: Both males and female beetles produced compounds with pheromonal activity. Preliminary laboratory and field bioassays indicate the presence of chemicals which appear to function as aggregating pheomones, anti-aggregating pheromones, and sex pheromones (female attracting male). All the pheromone components, except for one female produced alcohol have been unequivocally identified. Pheromone production changes throughout the spring emergence and attack period. Beetles must be allowed to emerge naturally in order to produce pheromones, but flight is not a necessary prerequiste for pheromone production.

ADDITIONAL WORK: Studies to investigate the utility of pheromones for monitoring and control of the cone beetle are continuing through a two-year cooperatve grant with the University of Georgia.

Cooperative Special Project

A special project to demonstrate and evaluate new techniques to control the white pine cone beetle. (Barber FPM, Wade & DeBarr SE and others) 1990-1991

RESPONSE OF Conopthorus coniperda TO CHEMICAL STIMULUS



1989 DIORYCTRIA DISCLUSA MATING DISRUPTION STUDY

Gary L. DeBarr, John C. Nord, and Christine G. Niwa

OBJECTIVE: To demonstrate the feasiblity of using MD to control the webbing coneworm in loblolly pine seed orchards.

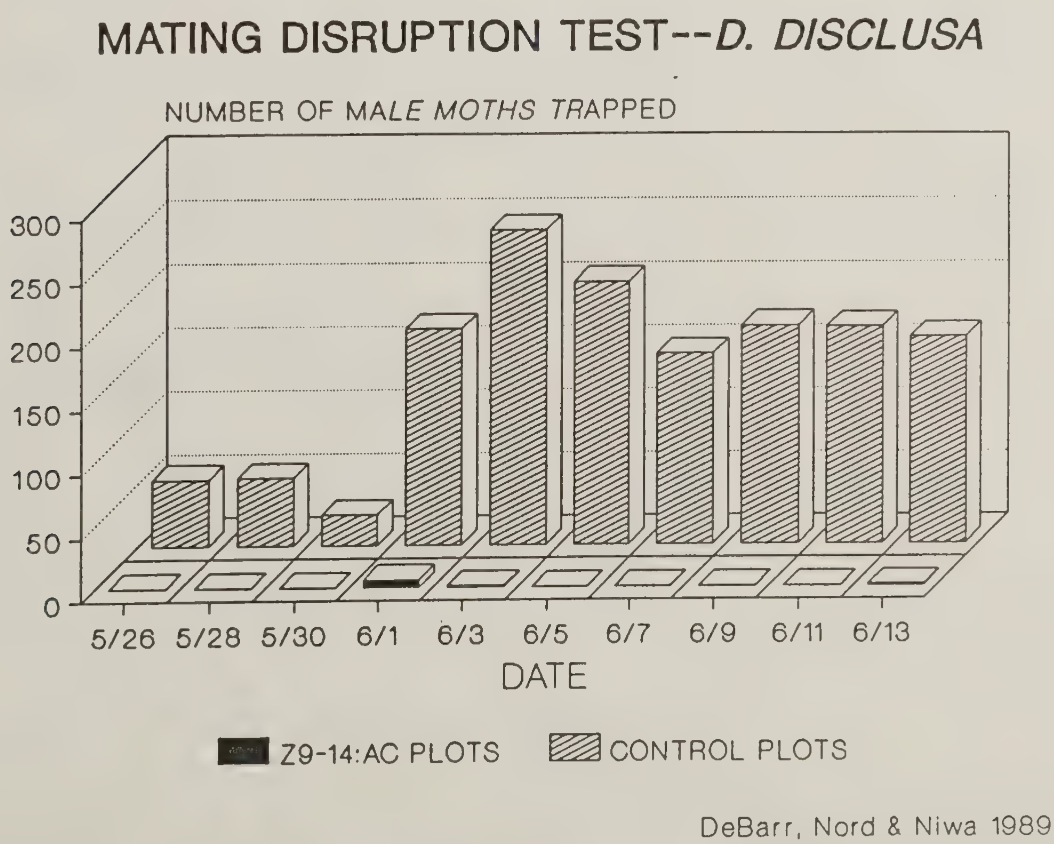
METHODS: Synthetic pheromone was released from PVC releasers placed in the mid- and upper crowns of 20 year old loblolly pines growing in the Meade Coated Board seed orchard, Putnam Co., Ga. The study was conducted in 2 plots of 3 acres each. Two releasers were suspended in each of 100 trees per plot for periods of 2 consecutive nights. Releasers were alternated between the two plots throughout the emergence period. The releasers contained 5 g of (Z)-9-tetradecenyl acetate per acre. Ten Pherocone 1C traps located in upper crowns of trees at the center of each plot were used to monitor male moth activity on treatment and non-treatment nights. The study was replicated in time, rather than space. The controls were nights without releasers; the treatments were nights with releasers in the trees.

RESULTS: Analyses showed that 35% of the pheromone was released during the 20 days of the test. Trap "shutdown" occurred on the nights the releasers were deployed. A total of 1507 D. disclusa males were trapped on control nights vs. 8 on treatment nights, for a 99.5% reduction in trap catch.

ADDITIONAL WORK: We will repeat this test during late August through early September to determine if (Z)-9-14:Ac will also disrupt D. merkeli. In additon, we will determine if (Z)-9-14:Ac permeation of the orchard will inhibit D. amatella.

Cooperative Special Project

A special project to demonstrate and evaluate control of the webbing coneworm, D. disclusa, by mating disruption. (Barber & Negron FPM, DeBarr & Nord SE, Daterman and Niwa PNW). 1990-1992,



APPENDIX B
John Taylor

Publications and Presentations from NAPIAP Funded Projects
Administered by Region 8 Forest Pest Management

Intensive monitoring of insecticide off-site movement in seed orchards located in three physiographic provinces in the South. (R8-2)

PUBLICATIONS

Neary, D. G., P. B. Bush, W. L. Nutter, and J. W. Taylor. 1989. Pesticide movement from Southern Pine Seed Orchards: I. Measured and Simulated Azinphosmethyl and Carbofuran in stormflow from a Georgia Piedmont Orchard. Submitted to Forest Science.

Nutter, W. L., P. B. Bush, D. G. Neary, R. McKenna, and J. W. Taylor. 1989. Pesticide Movement from Southern Pine Seed Orchards: II. Risk Assessment for insecticides in storm flow from a Georgia Piedmont Orchard. Submitted to Forest Science.

Taylor, J. W., D. G. Neary, and P. B. Bush. 1988. Pesticide residue sample collection. Protection Rep. R8-PR11. USDA For. Ser., Southern Region, Atlanta, GA. 5pp.

II) Insecticide distribution and persistence after spray application in Seed Orchards.

PUBLICATIONS

*Bush, P. B., W. L. Nutter, D. G. Neary and J. W. Taylor. 1989. Pesticide Movement from Southern Pine Seed Orchards: Use of CREAMS Model to facilitate evaluation of off-site pesticide movement. CREAMS/GLEAMS Symposium. Univ. of Georgia. Athens, Georgia.

III)Lindane Fate and Movement in an Upper Piedmont Forest Ecosystem. (R8-14)

THESIS:

James B. Feild, Water Movement and Chemical Transport in a Loblolly pine Forest. Masters Thesis, University of Georgia, Athens, Georgia.

Peter Ketcham, Groundwater Tracing in a North Georgia Piedmont Regolith by

Natural Oxygen-18 tracing, 1980. Masters Thesis Geology Department, University of Georgia, Athens, Georgia.

Joan Miller, Fate of Lindane in a Georgia Piedmont _Pinus taeda_ Plantation. Masters Thesis, University of Georgia, Athens, Georgia. 1989.

PUBLICATIONS:

Bush, P. B., J. F. Dowd, J. Miller, and J. W. Taylor. 1988. Collecting

Chemical and Physical parameters to describe pesticide movement in forested watersheds. Proceedings of Southern Weed Science Society, 41st Annual Meeting, Tulsa, Oklahoma.

Dowd, J. F., and A. G. Williams. 1989. Calibration and use of Pressure Transducers in Soil Hydrology. Hydrological Processes, Vol 3, pp-43-49.

Dowd, J. F., A. G. Williams, and P. B. Bush. 1989a. Influence of stemflow on lindane loading in the soil. Submitted to Water Resources Research.

Dowd, J. F., J. H. Miller, A. G. Williams, and P. B. Bush. 1989b. The Fate of lindane in a forested ecosystem. Submitted to Journal of Environmental Quality.

Abstract and Presentations at National and Regional Meetings

Bush, P. B. and J. F. Dowd. Pesticides in runoff from Forested Lands in the Southeast. American Chemical Society Symposium on Pesticide Runoff and Leaching Losses. American Chemical Society National Meeting, Dallas, Texas, 1989.

Bush, P. B., J. F. Dowd, A. G. Williams, D. G. Neary, and J. W. Taylor. Pesticides in Runoff from Forested Lands in the Southeast. Proceedings of a National Research Conference, "Pesticides in Terrestrial and Aquatic Environments", May 11-12, 1989, Richmond, VA; Virginia Water Resources Center, Virginia Polytechnical Institute and State University, W. R. Walker and D. L. Weigmann (eds.)

Dowd, J. F., A. G. Williams and P. B. Bush. Modelling the fate of lindane in a forested ecosystem. 7th Int. Cong. of Pest Chem. Hamburg, 1990.

Dowd, J. F., J. B. Feild, and P. B. Bush. 1989. Tracer movement in a Forest Soil. Annual Meeting of the Soil Science Society of America. Las Vegas, Nevada.

Field, J. B. Water movement and Chemical transport in a Loblolly Pine Forest. Georgia Water Resources Conference, University of Georgia, Athens, Georgia. 1989.

Wenner, D. B., D. Ketcham and J. Dowd. Charting changes in the stable isotopic composition of water during infiltration into the Regolith. Epstein 70th Birthday Symposium. Dec 1989, Calif. Inst. Tech. Pasadena, CA.

) Malathion Fate and Movement in an Upper Piedmont Forest Ecosystem. (R8-17)

THESIS:

Hemmen, K. Tracer studies of Water Movement in Soil Cores from near Comer, Georgia.

Veenendaal, A. Water Infiltration in a North Georgia Piedmont Soil: Evaluation of the Effects of Stemflow Loading.